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Silicon vacancy in SiC as a promising quantum system for single-defect and single-photon spectroscopy

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Abstract

Results of experiments are presented that suggest that the Si vacancy in SiC is a promising quantum system for single-defect and single-photon spectroscopy in the infrared region. The investigation was carried out with electron paramagnetic resonance (EPR), zero-field optically detected magnetic resonance (ODMR), direct-detection EPR (DD-EPR), and high-resolution fluorescence-excitation spectroscopy. Depending on the temperature, crystal polytype, and crystal position, two opposite schemes have been observed for the optical alignment of the populations of the spin sublevels of the high-spin ground state of the Si vacancy in SiC upon irradiation with unpolarized light at the zero-phonon lines (ZPLs). A giant change has been found in the luminescence intensity of the ZPLs in zero magnetic field upon the application of resonant microwaves which induce transitions between the spin sublevels of the vacancy ground state thus opening the possibility for magnetic-resonance detection of a single vacancy. The optical alignment of the populations of the spin sublevels in the ground state of the Si vacancy was shown with DD-EPR. Surprisingly narrow ZPLs of Si vacancies with a width less than 0.05 meV have been observed which seem to be the narrowest detected so far in SiC. © 2011 American Physical Society.

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